Fellowship and Practice Trends in Neuroradiology Training Programs in the United States

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BACKGROUND AND PURPOSE: Neuroradiology has become an increasingly diverse and subspecialized discipline. We evaluated the current status and trends affecting fellowship programs and the practice of clinical neuroradiology at academic medical centers, with emphasis on invasive procedures.

METHODS: All 85 program directors at Accreditation Council for Graduate Medical Education-approved fellowships in neuroradiology were sent a detailed questionnaire pertaining to various demographic aspects of their program and the performance of certain radiologic examinations of the brain and spine.

RESULTS: Sixty-seven programs (79%) responded. As many as 50% of programs are 1 year in length. Twenty-five percent of 2-year fellows leave their program after 1 year of training. During the past 5 years, 36% of programs have decreased in size and 73% reported a decline in the number of applicants. The majority (55%) of programs have had applicants renege on their commitment to begin a fellowship. Twenty percent of 2-year programs do not offer training in endovascular interventional procedures. Neurosurgeons perform endovascular interventional procedures at 18% of centers. There is an 18-fold variation in the volume of neuroangiographic procedures performed each year and a 150-fold variation in the volume of myelographic procedures performed. In 29% of programs, neuroradiologists are nonparticipants in nonvascular interventional spinal procedures; in 40%, they share these procedures with musculoskeletal radiologists/nonradiologists.

CONCLUSION: Interest in fellowship programs in neuroradiology is declining. An applicant’s commitment to either begin a fellowship or complete 2 years of training cannot be regarded with assurance, and there is a lack of uniformity in many areas of the training experience, particularly in invasive diagnostic and therapeutic procedures.

The specialty of neuroradiology has been affected by a number of changes during the past decade. For example, there has been a trend toward greater subspecialization, with the formation of separate American societies of interventional and therapeutic neuroradiology, head and neck radiology, spine radiology, and pediatric neuroradiology. Before the institution of the American Board of Radiology (ABR) examination for a Certificate of Added Qualification (CAQ) in neuroradiology in 1995, senior membership in the American Society of Neuroradiology (ASNR) was perhaps the most widely recognized measure of special competence in neuroradiology. The CAQ in neuroradiology has most certainly supplanted senior membership in the ASNR as the most important credential for a neuroradiologist. For trainees in neuroradiology, eligibility for the CAQ examination requires only 1 year of fellowship training (after residency) in a neuroradiology program approved for such training and accredited by the Accreditation Council for Graduate Medical Education (ACGME) and 1 year of practice or additional approved training (one third of that time) in neuroradiology (ABR communication).

Other changes have occurred in recent years. For example, there have been well-documented fluctuations in employment opportunities for radiology residents and fellows (1–8). Anecdotally, programs have had to contend with prospective trainees reneging on their commitment to begin a fellowship, as well as 2-year fellows leaving the training program after the completion of just the first year of training. Turf battles are currently being waged among neuroradiologists, neurosurgeons, cardiologists, and vascular surgeons over certain endovascular interventional procedures; pathways now exist...
for the training of neurosurgeons in interventional and therapeutic neuroradiology. Improvements in noninvasive CT and MR imaging have also had the potential to impact the volume of invasive procedures performed by neuroradiologists.

In an effort to systematically evaluate some of these trends, we surveyed the program directors at ACGME-approved fellowships in neuroradiology throughout the United States. The questionnaire focused on demographic aspects of fellowship training and on the practice of clinical neuroradiology at academic medical centers.

Methods

In September 2000, a cover letter and questionnaire, designed by one of the authors and titled “Practice and Fellowship Trends in Neuroradiology Training Programs,” were faxed to the program director of each ACGME-approved fellowship in neuroradiology throughout the United States (the questionnaire is available from D. P. Friedman). The 2000–2001 Graduate Medical Education Directory lists 85 ACGME-approved training programs. The questionnaire sought responses to 21 questions pertaining to various aspects of each clinical practice and training program, including program duration, program size, applicant pool, fulfillment of obligations by fellowship applicants and trainees, training in and performance of endovascular interventional neuroradiology, volume of angiography and myelography, performance of CT angiography, performance of nonvascular spinal interventions (eg, diskography, facet injections, vertebroplasty), interpretation of MR examinations of the spine ordered by orthopedic surgeons, performance of functional MR imaging, and available expertise in head and neck radiology, pediatric neuroradiology, and MR physics. The name of the responding institution was recorded at the top of the questionnaire. In November 2000, the cover letter and questionnaire were faxed a second time as well as mailed to those program directors who had not yet responded to the survey. The study was considered closed as of January 1, 2001, and all data were tabulated.

Results

Of the 85 programs surveyed, 67 (79%) responded by January 1, 2001; one institution indicated that it no longer offered a fellowship program. Hence, 66 programs constitute the basis of our results, although three programs did not respond to all of the questions in the survey. Twenty-four percent of programs are 1 year in length, 50% are 2 years in length, and the remaining 26% offer 1- or 2-year positions, according to the preferences of trainees. However, 25% of 2-year fellows leave their program after 1 year of training. Each program has an average of 2.2 fellows per year (range, 1–5). Thirty-six percent of programs have decreased in size during the past 5 years, while only 17% have increased in size. Seventy-three percent of programs reported a decline in the number of applicants during the past 5 years, while only 8% reported an increase. In the past 3 years, 55% of programs have had one or more applicants renege on a commitment to begin a fellowship. Twenty percent of 2-year programs do not offer any training in endovascular interventional neuroradiology.

Forty-five percent of trainees in either 1- or 2-year programs do not receive any exposure to endovascular interventional neuroradiology during the first year of their fellowship. Thirty-two percent of centers offer a separate fellowship in endovascular interventional neuroradiology. Diagnostic angiography is incorporated into a separate interventional neuroradiology rotation in 25% of programs. In 18% of programs, neurosurgeons perform some or all of the endovascular interventional procedures. The mean number of diagnostic neuroangiographic procedures performed per year is 478 (range, 100–1800; median, 350). CT angiography is performed routinely at 63% of the centers. The mean number of myelographic procedures performed per year is 263 (range, 10–1500; median, 150). Nonvascular interventional spinal procedures are performed at 92% of the centers. These procedures are performed exclusively by neuroradiologists at 32% of the centers; at the remainder, neuroradiologists either share these procedures with musculoskeletal radiologists or nonradiologists (40%) or they are nonparticipants (29%). In 12% of programs, MR examinations of the spine ordered by orthopedic surgeons are interpreted exclusively by musculoskeletal radiologists; in an additional 17% of programs, these studies are interpreted by musculoskeletal radiologists or neuroradiologists. Eighty-six percent of programs have one or more full-time MR physicists; 50% have a dedicated head and neck radiologist, and 44% have a dedicated pediatric radiologist. Functional MR imaging is performed on a routine basis at 62% of the centers.

Discussion

The results of this survey confirm that many changes are occurring in fellowship programs in neuroradiology in the United States. The high response rate to this questionnaire supports the validity of our results. Applications to neuroradiology fellowship training programs have been declining over the past 5 years. Moreover, more than one third of programs have decreased in size during this time. Regarding the current application cycle, the National Resident Matching Program (NRMP) has been instituted. For the training year beginning in July 2002, the list of participating physicians in the NRMP includes 81 applicants; the list of participating programs includes a total of 164 positions in the United States. These figures indicate that there are approximately two positions for each applicant enrolled in the match, and they do not account for positions filled by internal candidates. The fate of fellowship positions that are not filled by the NRMP cannot be determined by this survey. Our data also indicate that, depending on the preferences of fellowship applicants, between one quarter and one half of programs are 1 year in length. The actual percentage of 1-year programs varies from year to year. In addition, the number of de facto
1-year fellows is even greater, since one quarter of 2-year fellows complete just 1 year of training. What factors might account for these trends? Economic constraints faced by academic medical centers may have contributed to the reduction in size of some programs (9). As already suggested, training requirements for the CAQ examination in neuroradiology and the current strong employment market are important considerations. From June 1996 to May 1997, only 48 classified job advertisements were listed in the AJNR; from June 2000 to May 2001, 347 jobs were advertised (both figures include repeat listings). Indeed, a young radiologist at the PGY-6 level, perhaps heavily in debt, might find it very difficult to justify an additional year of training that is not mandated by the ABR. Fellowship training programs in other disciplines of radiology (eg, abdominal imaging, cardiovascular/interventional, musculoskeletal, chest, mammography) are usually 1 year in length. Given the long duration of training in diagnostic radiology (including a clinical year), does a required second year of fellowship training place programs in neuroradiology at a competitive disadvantage with other types of fellowships? Anecdotally, trainees have indicated that many advanced MR imaging techniques learned primarily during their fellowship (eg, MR spectroscopy, functional MR imaging) are not in wide use in the community setting and that such skills are not actively sought by prospective employers in private practice. On the other hand, experience with advanced MR imaging techniques is important for young academic neuroradiologists. Should 2-year programs be concentrated in a relatively small number of centers that prepare selected individuals for careers in academic medicine? Should the first year of a 2-year program be incorporated into the fourth year of residency? Substantial changes in the training program for radiology residents and fellows interested in the neurosciences have already been proposed (10, 11). It would also be interesting to compare the salaries, academic ranks, and retention rates of second-year fellows at different institutions.

In a disturbing trend, a majority of programs indicated that a number of accepted fellow applicants have reneged on their commitment to begin the fellowship. Anecdotally, these withdrawals have occurred as late as June, immediately before the start of the fellowship. Given the starting time of the academic year, these vacancies are almost impossible to fill. At a time when clinical demands upon faculty in academic medicine (as well as radiologists in private practice) are widely perceived to be increasing (in part, at least, to offset declining reimbursements) (12), the overall decline in trainee manpower cannot be regarded as a positive development.

We found a lack of uniformity in many areas of the fellowship training experience. For example, there is a 150-fold variation in the volume of myelography performed in the training programs responding to this survey. It is perhaps surprising that some academic medical centers still perform four to five myelographic examinations per day; on the other hand, 21 programs perform 100 studies or fewer per year. There is also an 18-fold variation in the volume of cerebral angiography performed. In some circumstances, the ability of a training program to meet current requirements of the ACGME for certain invasive procedures is unclear. Should these requirements be revised to reflect the impact of noninvasive imaging techniques upon the number of invasive procedures performed at some institutions?

To our surprise, approximately one fifth of 2-year programs do not offer any training in endovascular interventional neuroradiology. On the other hand, over half of the trainees in either 1- or 2-year programs receive at least some training in endovascular interventional procedures during the first year of their fellowship. It cannot be determined from this survey if the training offered to fellows in diagnostic neuroradiology merely constitutes exposure to the range of therapeutic techniques or if the training actually provides fellows with the skills necessary to perform these procedures independently. Since approximately one third of programs now offer a separate fellowship in interventional neuroradiology, these data suggest progressive divergence of the diagnostic and interventional neuroradiologic training pathways. In 25% of programs, diagnostic angiography is incorporated into a separate interventional neuroradiology rotation.

Our survey also showed that in approximately one fifth of centers with training programs in neuroradiology, some or all of the vascular interventional procedures are performed by neurosurgeons. In at least some of these centers, trainees in neuroradiology do not participate in these procedures. It would be interesting to know what percentage of fellows currently training in interventional neuroradiology are neurosurgeons. This survey did not assess the impact that other clinical specialties (eg, cardiology, vascular surgery) have had on the performance of neurovascular procedures, such as carotid stent placement and angioplasty. As long as newer therapeutic interventions (eg, coiling of aneurysms, carotid stent placement) have the potential to replace (as opposed to facilitate) surgical procedures, there is likely to be intense interest expressed by nonradiologists in learning these techniques. Similar concerns have been expressed by radiologists regarding the subspecialty of cardiovascular and interventional radiology (13, 14). Pathways now exist for the training of neurosurgeons in interventional and therapeutic neuroradiology.

Regarding nonvascular interventional spinal procedures (eg, diskography, facet injections, vertebroplasty), neuroradiologists are nonparticipants (29% of programs) or share these procedures with musculoskeletal radiologists and/or nonradiologists.
(40% of programs). On the basis of these data, we think it is likely that some trainees in neuroradiology are exposed to these procedures while others are not. Interpretation of MR examinations of the spine is shared with musculoskeletal radiologists in a minority of centers. Although CT angiography and functional MR imaging have been available for several years, approximately one third of centers do not routinely perform these techniques. The vast majority of training programs have one or more full-time MR physicists, and approximately half have dedicated head and neck radiologists and pediatric neuroradiologists (we acknowledge that the adjective dedicated is a subjective term).

While training programs in all disciplines of medicine have traditionally had strengths and weaknesses, the rapid technical advances in noninvasive neuroimaging and interventional procedures have likely contributed considerably to the above-described variability in clinical practice patterns and volume of invasive procedures. Neuroradiologists’ experience with newer noninvasive imaging techniques and interventional procedures, along with the confidence of clinicians in these techniques, is also an important consideration.

Organized neuroradiology, in conjunction with the various subspecialty societies, will need to determine whether any modifications in the status quo for training are required. It is imperative that the discipline of neuroradiology provide enough well-trained imaging subspecialists and interventionalists for the increasingly sophisticated clinical specialist (10). Our results should also be useful to future applicants seeking fellowship programs in neuroradiology.

What changes can be made in residency and fellowship programs that can better serve the subspecialty of neuroradiology and its trainees? In this era of increasing complexity of imaging techniques, it is imperative that additional training be made available in neuroradiology without inordinately extending the overall training period. A proposed 72-month curriculum leading to board certification in diagnostic radiology and neuroradiology is being developed by the executive committee of the ASNR (William Dillon, personal communication). This program is modeled after the Holman research pathway and the pathway for accreditation of interventional radiology recently approved by the ABR. With regard to the overall duration of training, this curriculum will enable neuroradiology to remain competitive with other radiologic subspecialties. At the same time, it will provide trainees with the skills needed to advance both the clinical and academic aspects of the specialty. This curriculum will also attract individuals who are strongly committed to a career in neuroradiology. We also believe that efforts should be made to maintain greater uniformity in the fellowship training experience with regard to both invasive and noninvasive imaging techniques. Perhaps there should be a formal separation of training pathways into invasive and noninvasive neuroradiology, thereby enabling trainees to focus on their areas of greatest interest and ability.

Conclusion

Our findings indicate that interest in fellowship programs in neuroradiology is declining. Moreover, an applicant’s commitment to either begin a fellowship or to complete 2 full years of training cannot be regarded with assurance. These trends may, in part, be attributed to 1) economic factors, 2) training requirements for the CAQ examination in neuroradiology, 3) the fluctuating employment market, and 4) increasing subspecialization in neuroradiology. There is a lack of uniformity in many areas of the fellowship training experience, particularly regarding invasive diagnostic and therapeutic procedures. Endovascular interventional neuroradiology is being performed by neurosurgeons in a small, but most likely growing, number of centers. Neuroradiologists also share nonvascular interventional spinal procedures with other radiologic and clinical subspecialties.

References

7. Dunnick NR. Employment in radiology is exceptionally high. Acad Radiol 1998;5:66–68